Contents

Number 306

Perspectives in Ecophysiology

RICHTER H. Water relations of plants in the field: some comments on the measurement of selected parameters 1

Research Papers

MARTINDALE W, PARRY MAJ, ANDRALOJC PJ, KEYS AJ. Synthesis of 2[1]-carboxy-D-arabinitol-1-phosphate in French bean (*Phaseolus vulgaris* L.): a search for precursors 9

CRUZ P. Effect of shade on the carbon and nitrogen allocation in a perennial tropical grass, *Dichanthium aristatum* 15

AMÉZIANE R, DELÉENS E, NOCTOR G, MOROT-GAUDRY J-F, LIMAMI MA. Stage of development is an important determinant in the effect of nitrate on photoassimilate (^{13}C) partitioning in chicory (*Cichorium intybus*) 25

COHEN S, MORESHET S, LE GUILLOU L, SIMON J-C, COHEN M. Response of citrus trees to modified radiation regime in semi-arid conditions 35

FRICKE W. Cell turgor, osmotic pressure and water potential in the upper epidermis of barley leaves in relation to cell location and in response to NaCl and air humidity 45

VUYLSTEKER C, HUSS B, RAMBOUR S. Nitrate reductase activity in chicory roots following excision 59

BAKER A, HILL GF, PARSONS R. Evidence for N feedback regulation of N_2 fixation in *Alnus glutinosa* L. 67

JESCHKE WD, KIRKBY EA, PEUKE AD, PATE JS, HARTUNG W. Effects of P deficiency on assimilation and transport of nitrate and phosphate in intact plants of castor bean (*Ricinus communis* L.) 75

MASSONNEAU A, CATHALA N, GRIGNON C, DAVIDIAN J-C. Effect of sulphate deficiency on the plasma membrane polypeptide composition of *Brassica napus* 93

PEET MM, WILLITS DH, GARDNER R. Response of ovule development and post-pollen production processes in male-sterile tomatoes to chronic, sub-acute high temperature stress 101

MULHOLLAND BJ, CRAIGON J, BLACK CR, COLLS JJ, ATHERTON J, LANDON G. Effects of elevated carbon dioxide and ozone on the growth and yield of spring wheat (*Triticum aestivum* L.) 113

LOZANO-RODRÍGUEZ E, HERNÁNDEZ LE, BONAY P, CARPENA-RUIZ RO. Distribution of cadmium in shoot and root tissues of maize and pea plants: physiological disturbances 123

ETIENNE H, LARTAUD M, CARRON MP, MICHAUX-FERRIÈRE N. Use of calcium to optimize long-term proliferation of friable embryogenic calluses and plant regeneration in *Hevea brasiliensis* (Müll. Arg.) 129

HINZ G, MENZE A, HOHL I, VAUX D. Isolation of prolegumin from developing pea seeds: its binding to endomembranes and assembly into prolegumin hexamers in the protein storage vacuole 139

DRAKE PMW, JOHN A, POWER JB, DAVEY MR. Expression of the *gus* A gene in embryogenic cell lines of Sitka spruce following *Agrobacterium*-mediated transformation 151

Methods Paper

BEILBY MJ, MIMURA T, SHIMMEN T. Perfusion of charophyte cells: a critical analysis of the method 157

Methods in Ecophysiology

GUIDI L, NALI C, CIOMPI S, LORENZINI G, SOLDATINI GF. The use of chlorophyll fluorescence and leaf gas exchange as methods for studying the different responses to ozone of two bean cultivars 173

Number 307

Perspectives in Experimental Botany

BUCHANAN-WOLLASTON V. The molecular biology of leaf senescence (Review article) 181

DOLAN L. The role of ethylene in the development of plant form (Review article) 201

KIEBER JJ. The ethylene signal transduction pathway in *Arabidopsis* (Review article) 211

Research Papers

MAYER W-E, HOHLOCH C, KALKUHL A. Extensor protoplasts of the *Phaseolus* pulvinus: light-induced swelling may require extracellular Ca^{2+} influx, dark-induced shrinking inositol 1, 4, 5-trisphosphate-induced Ca^{2+} mobilization 219

XING T, HIGGINS VJ, BLUMWALD E. Identification of G proteins mediating fungal elicitor-induced dephosphorylation of host plasma membrane H^+-ATPase 229

WEI LC, LOEPPERT RH, OCUMPAUGH WR. Fe-deficiency stress response in Fe-deficiency resistant and susceptible subterranean clover: importance of induced H^+ release 239

ROTH R, BOUDET AM, PONT-LEZICA R. Lignification and cinnamyl alcohol dehydrogenase activity in developing stems of tomato and poplar: a spatial and kinetic study through tissue printing 247

HALL RD, RIKSEN-BRUINSMA T, WEYENS G, LEFÈBVRE M, DUNWELL JM, VAN TUNEN A, KRENS FA. Sugar beet guard cell protoplasts demonstrate a remarkable capacity for cell division enabling applications in stomatal physiology and molecular breeding 255

WILKINSON JE, TWELL D, LINDSEY K. Activities of CaMV 35S and *nos* promotors in pollen: implications for field release of transgenic plants 265

DONG J-Z, PERRAS MR, ABRAMS SR, DUNSTAN DI. Gene expression patterns, and uptake and fate of fed ABA in white spruce somatic embryo tissues during maturation 277

SCHÖNING U, KOLLMANN R. Phloem translocation in regenerating *in vitro*-heterographs of different compatibility 289

THOMPSON JE, FRY SC. Trimming and solubilization of xylogucan after deposition in the walls of cultured rose cells 297

FISCUS EL, REID CD, MILLER JE, HEAGLE AS. Elevated CO_2 reduces O_3 flux and O_3-induced yield losses in soybeans: possible implications for elevated CO_2 studies 307

© Oxford Univesity Press 1997

YIN Z-H, RAVEN JA. A comparision of the impacts of various nitrogen sources on acid-base balance in C_3 *Triticum aestivum* L. and C_4 *Zea mays* L. plants 315
FADZILLA NM, FINCH RP, BURDON RH. Salinity, oxidative stress and antioxidant responses in shoot cultures of rice 325
ZWIENIECKI MA, BOERSMA L. A technique to measure root tip hydraulic conductivity and root water potential simultaneously 333
MEYER AJ, POPP M. Free Ca^{2+} in tissue saps of calciotrophic CAM plants as determined with Ca^{2+} selective electrodes 337

Short Communications
LEUNING R. Scaling to a common temperature improves the correlation between the photosynthesis parameters J_{max} and V_{cmax} 345
PÉRILLEUX C, BERNIER G, KINET J-M. Darkness promotes flowering in the absolute long-day requiring plant, *Lolium temulentum* L. Ceres 349

Special Issue

General Principles: Techniques and Models
TESTER M. Techniques for studying ion channels: an introduction 353
AMTMANN A, SANDERS D. A unified procedure for the correction of liquid junction potentials in patch clamp experiments on endo- and plasma membranes 361
HANSEN U-P, KEUNECKE M, BLUNCK R. Gating and permeation models of plant channels 365
MCCULLOCH SR, LAVER DR, WALKER NA. Anion channel activity in the *Chara* plasma membrane: co-operative subunit phenomena and a model 383
GRADMANN D, BUSCHMANN P. Oscillatory interactions between voltage gated electroenzymes 399

Molecular Properties
BERTL A, REID JD, SENTENAC H, SLAYMAN CL. Functional comparison of plant inward-rectifier channels expressed in yeast 405
HOTH S, DREYER I, HEDRICH R. Mutational analysis of functional domains within plant K^+ uptake channels 415
MAUREL C, CHRISPEELS M, LURIN C, TACNET F, GEELEN D, RIPOCHE P, GUERN J. Function and regulation of seed aquaporins 421

K^+ and Na^+ Pathways in Mineral Nutrition
ROBERTS SK, TESTER M. A patch clamp study of Na^+ transport in maize roots 431
DE BOER AH, WEGNER LH. Regulatory mechanisms of ion channels in xylem parenchyma cells 441
MAATHUIS FJM, SANDERS D. Regulation of K^+ absorption in plant root cells by external K^+: interplay of different plasma membrane K^+ transporters 451
TYERMAN SD, SKERRETT M, GARRILL A, FINDLAY GP, LEIGH RA. Pathways for the permeation of Na^+ and Cl^- into protoplasts derived from the cortex of wheat roots 459
AMTMANN A, LAURIE S, LEIGH R, SANDERS D. Multiple inward channels provide flexibility in Na^+/K^+ discrimination at the plasma membrane of barley suspension culture cells 481
WHITE PJ. Cation channels in the plasma membrane of rye roots 499

Ion Channels in Guard Cells
MACROBBIE EAC. Signalling in guard cells and regulation of ion channel activity 515
BLATT MR, GRABOV A. Signal redundancy, gates and integration in the control of ion channels for stomatal movement 529
ESSER JE, LIAO Y-J, SCHROEDER JI. Characterization of ion channel modulator effects on ABA- and malate-induced stomatal movements: strong regulation by kinase and phosphatase inhibitors, and relative insensitivity to mastoparans 539

Calcium Channels and Signal Transduction
PIÑEROS M, TESTER M. Calcium channels in higher plant cells: selectivity, regulation and pharmacology 551
TAYLOR A, MANISON N, BROWNLEE C. Regulation of channel activity underlying cell volume and polarity signals in *Fucus* 579
MUIR SR, BEWELL MA, SANDERS D, ALLEN GJ. Ligand-gated Ca^{2+} channels and Ca^{2+} signalling in higher plants 589
JOHANNES E, ERMOLAYEVA E, SANDERS D. Red light-induced membrane potential transients in the moss *Physcomitrella patens*: ion channel interaction in phytochrome signalling 599
THIEL G, HOMANN U, PLIETH C. Ion channel activity during the action potential in *Chara*: new insights with new techniques 609

Malate Channels and Metabolite Compartmentation
CHEFFINGS CM, PANTOJA O, ASHCROFT FM, SMITH JAC. Malate transport and vacuolar ion channels in CAM plants 623

Number 308

Perspectives in Experimental Botany
DAVIES JM. Vacuolar energization: pumps, shunts and stress (SEB President's medal review article) 633

Research Papers
WELBAUM GE, BIAN D, HILL DR, GRAYSON RL, GUNATILAKA MK. Freezing tolerance, protein composition, and abscisic acid localization and content of pea epicotyl, shoot, and root tissue in response to temperature and water stress 643
COCHARD H, PEIFFER M, LE GALL K, GRANIER A. Developmental control of xylem hydraulic resistances and vulnerability to embolism in *Fraxinus excelsior* L.: impacts on water relations 655
ALDER NN, POCKMAN WT, SPERRY JS, NUISMER S. Use of centrifugal force in the study of xylem cavitation 665
WANG N, ZHANG H, NOBEL PS. Phloem–xylem water flow in developing cladodes of *Opuntia ficus-indica* during sink-to-source transition 675
HOU JQ, KENDALL EJ, SIMPSON GM. Water uptake and distribution in non-dormant and dormant wild oat (*Avena fatua* L.) caryopses 683
KOYRO H-W. Ultrastructural and physiological changes in root cells of *Sorghum* plants (*Sorghum bicolor* × *S. sudanensis* cv. Sweet Sioux) induced by NaCl 693
PERERA LKRR, DE SILVA DLR, MANSFIELD TA. Avoidance of sodium accumulation by the stomatal guard cells of the halophyte *Aster tripolium* 707

DOLAN L, LINSTEAD P, ROBERTS K. Developmental regulation of pectic polysaccharides in the root meristem of *Arabidopsis* 713
DING B-L, SCHOPFER P. Metabolic involvement in acid-mediated extension growth of maize coleoptiles 721
MACKERNESS SA-H, THOMAS B, JORDAN BR. The effect of supplementary ultraviolet-B radiation on mRNA transcripts, translation and stability of chloroplast proteins and pigment formation in *Pisum sativum* L. 729
FROHNMEYER H, BOWLER C, SCHÄFER E. Evidence for some signal transduction elements involved in UV-light dependent responses in parsley protoplasts 739
JAIN RK, DAVEY MR, COCKING EC, WU R. Carbohydrate and osmotic requirements for high-frequency plant regeneration from protoplast-derived colonies of indica and japonica rice varieties 751
PICH A, HILLMER S, MANTEUFFEL R, SCHOLZ G. First immunohistochemical localization of the endogenous Fe^{2+}-chelator nicotianamine 759
AGGELIS A, JOHN I, GRIERSON D. Analysis of physiological and molecular changes in melon (*Cucumis melo* L.) varieties with different rates of ripening 769
DIPIERRO S, DE LEONARDIS S. The ascorbate system and lipid peroxidation in stored potato (*Solanum tuberosum* L.) tubers 779
JAMES EK, OLIVARES FL, BALDANI JI, DÖBEREINER J. *Herbaspirillum*, an endophytic diazotroph colonizing vascular tissue in leaves of *Sorghum bicolor* L. Moench 785
MAURINO VG, DRINCOVICH MF, CASATI P, ANDREO CS, EDWARDS GE, KU MSB, GUPTA SK, FRANCESCHI VR. NADP-malic enzyme: immunolocalization in different tissues of the C_4 plant maize and the C_3 plant wheat 799

Methods in Ecophysiology
IRVINE J, GRACE J. Non-destructive measurement of stem water content by time domain reflectometry using short probes 813

Book Review
SALT DT. Evolution: the four billion year war. M Majerus, W Amos and G Hurst 819

Number 309

Perspectives in Experimental Botany
VAN DOORN WG, STEAD AD. Abscission of flowers and floral parts (Review article) 821

Research Papers
ROBERTS SK, TESTER M. Permeation of Ca^{2+} and monovalent cations through an outwardly rectifying channel in maize root stelar cells 839
SAVIDOV NA, TOKAREV BI, LIPS SH. Regulation of Mo-cofactor, NADH- and NAD(P)H-specific nitrate reductase activities in the wild type and two *nar*-mutant lines of barley (*Hordeum vulgare* L.) 847
ROSENBERG LA, PADGETT PE, ASSMANN SM, WALLING LL, LEONARD RT. Identification of mRNAs and proteins in higher plants using probes from the Band 3 anion transporter of mammals 857
SQUIRE GR, MARSHALL B, DUNLOP G, WRIGHT G. Genetic basis of rate-temperature characteristics for germination in oilseed rape 869
COLLINSON ST, CLAWSON EJ, AZAM-ALI SN, BLACK CR. Effects of soil moisture deficits on the water relations of bambara groundnut (*Vigna subterranea* L. Verdc.) 877
BENGOUGH AG, MCKENZIE BM. Sloughing of root cap cells decreases the frictional resistance to maize (*Zea mays* L.) root growth 885
GORDON AJ, JAMES CL. Enzymes of carbohydrate and amino acid metabolism in developing and mature nodules of white clover 895
ARRESE-IGOR C, MINCHIN FR, GORDON AJ, NATH AK. Possible causes of the physiological decline in soybean nitrogen fixation in the presence of nitrate 905
JESCHKE WD, BAIG A, HILPERT A. Sink-stimulated photosynthesis, increased transpiration and increased demand-dependent stimulation of nitrate uptake: nitrogen and carbon relations in the parasitic association *Cuscuta reflexa–Coleus blumei* 915
RENGEL Z, WHEAL MS. Herbicide chlorsulfuron decreases growth of fine roots and micronutrient uptake in wheat genotypes 927
RENGEL Z, WHEAL MS. Kinetic parameters of Zn uptake by wheat are affected by herbicide chlorsulfuron 935
KESTER ST, GENEVE RL, HOUTZ RL. Priming and accelerated ageing affect L-isoaspartyl methyltransferase activity in tomato (*Lycopersicon esculentum* Mill.) seed 943
PUDDEPHAT IJ, ALDERSON PG, WRIGHT NA. Influence of explant source, plant growth regulators and culture environment on culture initiation and establishment of *Quercus robur* L. *in vitro* 951
TONKINSON CL, LYNDON RF, ARNOLD GM, LENTON JR. The effects of temperature and the *Rht3* dwarfing gene on growth, cell extension, and gibberellin content and responsiveness in the wheat leaf 963
CORKE FMK, ROBERTS K. Large changes in the population of cell wall proteins accompany the shift to cell elongation 971

Short Communication
KAILE A. Cholesterol-modulated ion channel activity in tonoplast vesicles: a planar lipid bilayer study 979

Number 310

Perspectives in Experimental Botany
FRENSCH J. Primary responses of root and leaf elongation to water deficits in the atmosphere and soil solution (Opinion paper) 985

Research Papers
WINKEL T, RENNO J-F, PAYNE WA. Effect of the timing of water deficit on growth, phenology and yield of pearl millet (*Pennisetum glaucum* [L] R. Br.) grown in Sahelian conditions 1001
ROUSSIS A, PAPADOPOULOU K, KATINAKIS P. NOD3, a novel late nodulin gene from soybean is expressed in the infected cells and the nodule parenchyma 1011
ZAK EA, SOKOLOV OI, GREENGAUZ OK, BOCHAROVA MA, KLYACHKO NL. Polysomes from *Vicia faba* L. leaves bound to the actin cytoskeleton 1019
WOLTERING EJ, DE VRIJE T, HARREN F, HOEKSTRA FA. Pollination and stigma wounding: same response, different signal? 1027
KIRSCH T, KAFFARNIK F, RIEDERER M, SCHREIBER L. Cuticular permeability of the three tree species *Prunus laurocerasus* L., *Ginkgo biloba* L. and *Juglans regia* L.: comparative investigation of the transport properties of intact leaves, isolated cuticles and reconstituted cuticular waxes 1035

TENNAKOON KU, PATE JS, FINERAN BA. Growth and partitioning of C and fixed N in the shrub legume *Acacia littorea* in the presence or absence of the root hemiparasite *Olax phyllanthi* 1047

TENNAKOON KU, PATE JS. Xylem fluxes of fixed N through nodules of the legume *Acacia littorea* and haustoria of an associated N-dependent root hemiparasite *Olax phyllanthi* 1061

BERNIER G. Growth changes in the shoot apex of *Sinapis alba* during transition to flowering 1071

VUYLSTEKER C, LELEU O, RAMBOUR S. Influence of BAP and NAA on the expression of nitrate reductase in excised chicory roots 1079

GRIMM E, JAHNKE S, ROTHE K. Photoassimilate translocation in the petiole of *Cyclamen* and *Primula* is independent of lateral retrieval 1087

MERK S, RIEDERER M. Sorption of volatile C1 to C6 alkanols in plant cuticles 1095

HODGES DM, ANDREWS CJ, JOHNSON DA, HAMILTON RI. Antioxidant enzyme responses to chilling stress in differentially sensitive inbred maize lines 1105

KINRAIDE TB. Reconsidering the rhizotoxicity of hydroxyl, sulphate and fluoride complexes of aluminium 1115

Methods Paper

BAKER CJ. Measurements of the natural frequencies of trees 1125

Perspectives in Ecophysiology

MONCRIEFF J, VALENTINI R, GRECO S, SEUFERT G, CICCIOLI P. Trace gas exchange over terrestrial ecosystems: methods and perspectives in micrometeorology 1133

Short Communications

FAMBRINI M, SEBASTIANI L, ROSSI V, CAVALLINI A, PUGLIESI C. Genetic analysis of an electrophoretic variant for the chloroplast-associated form of Cu/Zn superoxide dismutase in sunflower (*Helianthus annuus* L.) 1143

DAYKIN A, SCOTT IM, CAUSTON DR, FRANCIS D. Gibberellin does not accelerate rates of cell division in the dwarf pea shoot apical meristem 1147

Number 311

Perspectives in Experimental Botany

PRIOUL J-L, QUARRIE S, CAUSSE M, DE VIENNE D. Dissecting complex physiological functions through the use of molecular quantitative genetics (Review article) 1151

Cell and Molecular Biology and Biochemistry

SUGANUMA N, OKADA Y, KANAYAMA Y. Isolation of a cDNA for nodule-enhanced phospho*enol*pyruvate carboxylase from pea and its expression in effective and plant-determined ineffective pea nodules 1165

MIGGE A, CARRAYOL E, KUNZ C, HIREL B, FOCK H, BECKER T. The expression of the tobacco genes encoding plastidic glutamine synthetase or ferredoxin-dependent glutamate synthase does not depend on the rate of nitrate reduction, and is unaffected by suppression of photorespiration 1175

RAMANATHAN V, SIMPSON CG, THOW G, IANNETTA PPM, MCNICOL RJ, WILLIAMSON B. cDNA cloning and expression of polygalacturonase-inhibiting proteins (PGIPs) from red raspberry (*Rubus idaeus*) 1185

JIAN L-C, LI PH, SUN L-H, CHEN THH. Alterations in ultrastructure and subcellular localization of Ca^{2+} in poplar apical bud cells during the induction of dormancy 1195

BAYDOUN EA-H, BRETT CT. Distribution of xylosyltransferases and glucuronyltransferase within the Golgi apparatus in etiolated pea (*Pisum sativum* L.) epicotyls 1209

LIEDTKE C, POLSAKIEWICZ M, HARTMANN I, PETERS P, VOLKMANN D, SCHERER GF. Biochemical and immunocytochemical characterization of monoclonal antibody TOP 35 raised against purified tonoplast from cress root 1215

HARRIS N, TAYLOR JE, ROBERTS JA. Characterization and expression of an mRNA encoding a wound-induced (Win) protein from ethylene-treated tomato leaf abscission zone tissue 1223

Regulation of Growth, Development and Whole Organism Physiology

JESCHKE WD, HOLOBRADÁ M, HARTUNG W. Growth of *Zea mays* L. plants with their seminal roots only. Effects on plant development, xylem transport, mineral nutrition and the flow and distribution of abscisic acid (ABA) as a possible shoot-to-root signal 1229

LEXA M, CHEESEMAN JM. Growth and nitrogen relations in reciprocal grafts of wild-type and nitrate reductase-deficient mutants of pea (*Pisum sativum* L. var. Juneau) 1241

SHIMADA S, ROUSSEAU R, DENISON RF. Wavelength options for monitoring leghaemoglobin oxygenation gradients in intact legume root nodules 1251

MALUF MP, SAAB IN, WURTZEL ET, SACHS MM. The *viviparous12* maize mutant is deficient in abscisic acid, carotenoids and chlorophyll synthesis 1259

QUARTACCI MF, FORLI M, RASCIO N, DALLA VECCHIA F, BOCHICCHIO A, NAVARI-IZZO F. Desiccation-tolerant *Sporobolus stapfianus*: lipid composition and cellular ultrastructure during dehydration and rehydration 1269

Plants and the Environment

SOCIAS X, CORREIA MJ, CHAVES M, MEDRANO H. The role of abscisic acid and water relations in drought responses of subterranean clover 1281

HOGAN KP, FLECK I, BUNGARD R, CHEESEMAN JM, WHITEHEAD D. Effect of elevated CO_2 on the utilization of light energy in *Nothofagus fusca* and *Pinus radiata* 1289

STRAUB PF, SHEARER G, REYNOLDS PHS, SAWYER SA, KOHL DH. Effect of disabling bacteroid proline catabolism on the response of soybeans to repeated drought stress 1299

CASELLA E, SOUSSANA JF. Long-term effects of CO_2 enrichment and temperature increase on the carbon balance of a temperate grass sward 1309

MENCUCCINI M, COMSTOCK J. Vulnerability to cavitation in populations of two desert species, *Hymenoclea salsola* and *Ambrosia dumosa*, from different climatic regions 1323

Book Review

BRYANT JA. Embryogenesis: the generation of a plant. TL Wang and A Cuming 1335

Number 312

Perspectives in Experimental Botany

BETHKE PC, SCHUURINK R, JONES RL. Hormonal signalling in cereal aleurone (Review article) 1337

Cell and Molecular Biology and Biochemistry

STILLER J, MARTIRANI L, TUPPALE S, CHIAN R-J, CHIURAZZI M, GRESSHOFF PM. High frequency transformation and regeneration of transgenic plants in the model legume *Lotus japonicus* 1357

KAISER WM, HUBER SC. Correlation between apparent activation state of nitrate reductase (NR), NR hysteresis and degradation of NR protein 1367

HERNÁNDEZ LE, COOKE DT. Modification of the root plasma membrane lipid composition of cadmium-treated *Pisum sativum* 1375

MCCULLOCH SR, BEILBY MJ. The electrophysiology of plasmolysed cells of *Chara australis* 1383

BALESTRAZZI A, LUO M, CELLA R. Gene amplification and enzyme modification are responsible for the methotrexate-resistance of two carrot cell lines that overproduce bifunctional dihydrofolate reductase-thymidylate synthase 1393

Regulation of Growth, Development and Whole Organism Physiology

MINCHIN PEH, THORPE MR, WÜNSCHE JN, PALMER JW, PICTON RF. Carbon partitioning between apple fruits: short- and long-term response to availability of photosynthate 1401

GOINS GD, YORIO NC, SANWO MM, BROWN CS. Photomorphogenesis, photosynthesis, and seed yield of wheat plants grown under red light-emitting diodes (LEDs) with and without supplemental blue lighting 1407

KAWAKAMI N, MIYAKE Y, NODA K. ABA insensitivity and low ABA levels during seed development of non-dormant wheat mutants 1415

CHAUVAUX N, CHILD R, JOHN K, ULVSKOV P, BORKHARDT B, PRINSEN E, VAN ONCKELEN HA. The role of auxin in cell separation in the dehiscence zone of oilseed rape pods 1423

KREUZWIESER J, HERSCHBACH C, STULEN I, WIERSEMA P, VAALBURG W, RENNENBERG H. Interactions of NH_4^+ and L-glutamate with NO_3^- transport processes of non-mycorrhizal *Fagus sylvatica* roots 1431

Plants and the Environment

BIEHLER K, HAUPT S, BECKMANN J, FOCK H, BECKER TW. Simultaneous CO_2- and $^{16}O_2/^{18}O_2$-gas exchange and fluorescence measurements indicate differences in light energy dissipation between the wild type and the phytochrome-deficient *aurea* mutant of tomato during water stress 1439

THALER P, PAGÈS L. Competition within the root system of rubber seedlings (*Hevea brasiliensis*) studied by root pruning and blockage 1451

KONDRACKA A, RYCHTER AM. The role of P_i recycling processes during photosynthesis in phosphate-deficient bean plants 1461

USHERWOOD JR, ENNOS AR, BALL DJ. Mechanical and anatomical adaptations in terrestrial and aquatic buttercups to their respective environments 1469

BAXTER R, ASHENDEN TW, FARRAR JF. Effect of elevated CO_2 and nutrient status on growth, dry matter partitioning and nutrient content of *Poa alpina* var. *vivipara* L. 1477

Short Communication

HEATH J, KERSTIENS G, TYREE MT. Stem hydraulic conductance of European beech (*Fagus sylvatica* L.) and pedunculate oak (*Quercus robur* L.) grown in elevated CO_2 1487

Book Review

EVANS DE. Instrumental analysis and multi-element analysis of plant samples: methods and applications. B Markert 1491

Number 313

Perspectives in Experimental Botany

DODEMAN VL, DUCREUX G, KREIS M. Zygotic embryogenesis versus somatic embryogenesis (Review article) 1493

Cell and Molecular Biology, Biochemistry and Molecular Physiology

SCHÜTZ K, TYERMAN SD. Water channels in *Chara corallina* 1511

CARNICELLI D, BRIGOTTI M, ALVERGNA P, PALLANCA A, SPERTI S, MONTANARO L. Cofactor requirement of ribosome-inactivating proteins from plants 1519

VASHAKMADZE GS, TUCKER GA. Tomato vesicles as a model system for studying *in situ* activity of 1-aminocyclopropane-1-carboxylic acid oxidase 1525

OLMOS E, HELLÍN E. Cytochemical localization of ATPase plasma membrane and acid phosphatase by cerium-based method in a salt-adapted cell line of *Pisum sativum* 1529

YADAV JS, RAJAM MV. Spatial distribution of free and conjugated polyamines in leaves of *Solanum melongena* L. associated with differential morphogenetic capacity: efficient somatic embrogenesis with putrescine 1537

Regulation of Growth, Development and Whole Organism Physiology

PICON C, FERHI A, GUEHL J-M. Concentration and $\delta^{13}C$ of leaf carbohydrates in relation to gas exchange in *Quercus robur* under elevated CO_2 and drought 1547

ZHANG J, JIA W, ZHANG D. Re-export and metabolism of xylem-delivered ABA in attached maize leaves under different transpirational fluxes and xylem ABA concentrations 1557

ZHANG WH, WALKER NA, TYERMAN SD, PATRICK JW. Mechanisms of solute efflux from seed coats: whole-cell K^+ currents in transfer cell protoplasts derived from coats of developing seeds of *Vicia faba* L. 1565

Plants and the Environment

CLIFTON-BROWN JC, JONES MB. The thermal response of leaf extension rate in genotypes of the C_4-grass *Miscanthus*: an important factor in determining the potential productivity of different genotypes 1573

KAISER H, KAPPEN L. *In situ* observations of stomatal movements in different light–dark regimes: the influence of endogenous rhythmicity and long-term adjustments 1583

OLESEN JE, GREVSEN K. Effects of temperature and irradiance on vegetative growth of cauliflower (*Brassica oleracea* L. *botrytis*) and broccoli (*Brassica oleracea* L. *italica*) 1591

COMMÉNIL P, BRUNET L, AUDRAN J-C. The development of the grape berry cuticle in relation to susceptibility to bunch rot disease 1599

Methods Paper

MÜHLING KH, SATTELMACHER B. Determination of apoplastic K^+ in intact leaves by ratio imaging of PBFI fluorescence 1609

Number 314

Perspectives in Experimental Botany

VAN DOORN WG. Effects of pollination on floral attraction and longevity (Review article) 1615

Cell and Molecular Biology, Biochemistry and Molecular Physiology

BLOM-ZANDSTRA M, KOOT H, VAN HATTUM J, VOGELZANG SA. Transient light-induced changes in ion channel and proton pump activites in the plasma membrane of tobacco mesophyll protoplasts 1623

DE VRIJE T, MUNNIK T. Activation of phospholipase D by calmodulin antagonists and mastoparan in carnation petals 1631

STIEGER PA, FELLER U. Requirements for the light-stimulated degradation of stromal proteins in isolated pea (*Pisum sativum* L.) chloroplasts 1639

Regulation of Growth, Development and Whole Organism Physiology

THAVARUNGKUL P. Vibrating probe measurement of ionic currents around developing embryo of oil palm (*Elaeis guineensis* Jacq.) 1647

FAN TW-M, HIGASHI RM, FRENKIEL TA, LANE AN. Anaerobic nitrate and ammonium metabolism in flood-tolerant rice coleoptiles 1655

GARCÍA-PLAZAOLA JI, FARIA T, ABADÍA J, ABADÍA A, CHAVES MM, PEREIRA JS. Seasonal changes in xanthophyll composition and photosynthesis of cork oak (*Quercus suber* L.) leaves under mediterranean climate 1667

NAOR A, GAL Y, BRAVDO B. Crop load affects assimilation rate, stomatal conductance, stem water potential and water relations of field-grown Sauvignon blanc grapevines 1675

Plants and the Environment

CEULEMANS R, TAYLOR G, BOSAC C, WILKINS D, BESFORD RT. Photosynthetic acclimation to elevated CO_2 in poplar grown in glasshouse cabinets or in open top chambers depends on duration of exposure 1681

MACDUFF JH, BAKKEN AK, DHANOA MS. An analysis of the physiological basis of commonality between diurnal patterns of NH_4^+, NO_3^- and K^+ uptake by *Phleum pratense* and *Festuca pratensis* 1691

CROOK MJ, ENNOS AR, BANKS JR. The function of buttress roots: a comparative study of the anchorage systems of buttressed (*Aglaia* and *Nephelium ramboutan* species) and non-buttressed (*Mallotus wrayi*) tropical trees 1703

HAN B, BERJAK P, PAMMENTER N, FARRANT J, KERMODE AR. The recalcitrant plant species, *Castanospermum australe* and *Trichilia dregeana*, differ in their ability to produce dehydrin-related polypeptides during seed maturation and in response to ABA or water-deficit-related stresses 1717

CORREIA MJ, RODRIGUES ML, FERREIRA MI, PEREIRA JS. Diurnal change in the relationship between stomatal conductance and abscisic acid in the xylem sap of field-grown peach trees 1727

JESCHKE WD, PEUKE AD, PATE JS, HARTUNG W. Transport, synthesis and catabolism of abscisic acid (ABA) in intact plants of castor bean (*Ricinus communis* L.) under phosphate deficiency and moderate salinity 1737

Gene Note

BURBIDGE A, GRIEVE T, TERRY C, CORLETT J, THOMPSON A, TAYLOR I. Structure and expression of a cDNA encoding zeaxanthin epoxidase, isolated from a wilt-related tomato (*Lycopersicon esculentum* Mill.) library 1749

Book Reviews

BARDGETT R. Plant–microbial symbiosis: molecular approaches. AH Fitter and DP Stribley 1751

MALLOCH A. Experiments in ecology: their logical design and interpretation using analysis of variance. AJ Underwood 1752

Number 315

Perspective in Experimental Botany

TYREE MT. The Cohesion-Tension theory of sap ascent: current controversies (Review article) 1753

Cell and Molecular Biology, Biochemistry and Molecular Physiology

OLBE M, WIDELL S, SOMMARIN M. Active calcium transporters in isolated membranes of wheat root cells 1767

LOHAUS G, HELDT H-W. Assimilation of gaseous ammonia and the transport of its products in barley and spinach leaves 1779

CUTLER AJ, SQUIRES TM, LOEWEN MK, BALSEVICH JJ. Induction of (+)-abscisic acid 8′ hydroxylase by (+)-abscisic acid in cultured maize cells 1787

Regulation of Growth, Development and Whole Organism Physiology

HODGE A, PATERSON E, THORNTON B, MILLARD P, KILLHAM K. Effects of photon flux density on carbon partitioning and rhizosphere carbon flow of *Lolium perenne* 1797

WRIGHT KM, OPARKA KJ. Metabolic inhibitors induce symplastic movement of solutes from the transport phloem of *Arabidopsis* roots 1807

GENTER T, DELÉENS E, FLEURY A. Influence of photosynthetic restriction due to defoliation at flowering on seed abortion in lucerne (*Medicago sativa* L.) 1815

ZOTZ G, PATIÑO S, TYREE MT. Water relations and hydraulic architecture of woody hemiepiphytes 1825

Plants and the Environment

EPRON D. Effects of drought on photosynthesis and on the thermotolerance of photosystem II in seedlings of cedar (*Cedrus atlantica* and *C. libani*) 1835

BOOKER FL, REID CD, BRUNSCHÖN-HARTI S, FISCUS EL, MILLER JE. Photosynthesis and photorespiration in soybean [*Glycine max* (L.) Merr.] chronically exposed to elevated carbon dioxide and ozone 1843

MULHOLLAND BJ, CRAIGON J, BLACK CR, COLLS JJ, ATHERTON J, LANDON G. Impact of elevated atmospheric CO_2 and O_3 on gas exchange and chlorophyll content in spring wheat (*Triticum aestivum* L.) 1853

MARTINDALE W, LEEGOOD RC. Acclimation of photosynthesis to low temperature in *Spinacia oleracea* L. I. 1865

MARTINDALE W, LEEGOOD RC. Acclimation of photosynthesis to low temperature in *Spinacia oleracea* L. II. 1873

Number 316

Perspectives in Experimental Botany

MILLER DD, DE RUIJTER NCA, EMONS AMC. From signal to form: aspects of the cytoskeleton-plasma membrane-cell wall continuum in root hair tips (Review article) 1881

Cell and Molecular Biology, Biochemistry and Molecular Physiology

ŠEBELA M, LUHOVÁ L, FRÉBORT I, HIROTA S, FAULHAMMER HG, STUŽKA V, PEČ P. Confirmation of the presence of a Cu(II)/topa quinone active site in the amine oxidase from fenugreek seedlings 1897

SCHMIDT A, BUCKHOUT TJ. The response of tomato roots (*Lycopersicon esculentum* Mill.) to iron deficiency stress: alterations in the pattern of protein synthesis 1909

BARG R, PILOWSKY M, SHABTAI S, CARMI N, SZECHTMAN AD, DEDICOVA B, SALTS Y. The TYLCV-tolerant tomato line MP-1 is characterized by superior transformation competence 1919

Regulation of Growth, Development and Whole Organism Physiology

LANUBILE R, PIRO G, DALESSANDRO G. Effect of Brefeldin A on the synthesis and transport of cell wall polysaccharides and proteins in pea root seedlings 1925

TRICOT F, CROZAT Y, PELLERIN S. Root system growth and nodule establishment on pea (*Pisum sativum* L.) 1935

PATIL VR, WIDHOLM JM. Possible correlation between increased vigour and chitinase activity expression in tobacco 1943

KUZNETSOV OA, HASENSTEIN KH. Magnetophoretic induction of curvature in coleoptiles and hypocotyls 1951

Plants and the Environment

KÖHL KI. Do *Armeria maritima* (Mill.) Willd. ecotypes from metalliferous soils and non-metalliferous soils differ in growth response under Zn stress? A comparison by a new artificial soil method 1959

HOAD SP, GRACE J, JEFFREE CE. Humidity response of cuticular conductance of beech (*Fagus sylvatica* L.) leaf discs maintained at high relative water content 1969

STEPHANOU M, MANETAS Y. The effects of seasons, exposure, enhanced UV-B radiation and water stress on leaf epicuticular and internal UV-B absorbing capacity of *Cistus creticus*: a Mediterranean field study 1977

Methods Paper

BACANAMWO M, PURCELL LC, SERRAJ R. Closed system O_2 uptake: a simple technique of nodule oxygen permeability estimation 1987

Number 317

Perspectives in Experimental Botany

EMES MJ, NEUHAUS HE. Metabolism and transport in non-photosynthetic plastids (Review article) 1995

Cell and Molecular Biology, Biochemistry and Molecular Physiology

KUREPA J, VAN MONTAGU M, INZÉ D. Expression of *sodCp* and *sodB* genes in *Nicotiana tabacum*: effects of light and copper excess 2007

WOJTASZEK P, STOBIECKI M, BOLWELL GP. Changes in the composition of exocellular proteins of suspension-cultured *Lupinus albus* cells in response to fungal elicitors or $CuCl_2$ 2015

SIEFERT F, GROSSMANN K. Induction of chitinase and β-1,3-glucanase activity in sunflower suspension cells in response to an elicitor from *Phytophthora megasperma* f. sp. *glycinea* (Pmg). Evidence for regulation by ethylene and 1-aminocyclopropane-1-carboxylic acid (ACC) 2023

STASWICK P. The occurrence and gene expression of vegetative storage proteins and a Rubisco Complex Protein in several perennial soybean species 2031

Regulation of Growth, Development and Whole Organism Physiology

CROXDALE J, COOK M, TIBBITTS TW, BROWN CS, WHEELER RM. Structure of potato tubers formed during spaceflight 2037

SCHNEIDER H, WISTUBA N, MILLER B, GEßNER P, THÜRMER F, MELCHER P, MEINZER F, ZIMMERMANN U. Diurnal variation in the radial reflection coefficient of intact maize roots determined with the xylem pressure probe 2045

ELZENGA JTM, STAAL M, PRINS HBA. Calcium-calmodulin signalling is involved in light-induced acidification by epidermal leaf cells of pea, *Pisum sativum* L. 2055

WHITE PJ. The regulation of K^+ influx into roots of rye (*Secale cerale* L.) seedlings by negative feedback via the K^+ flux from shoot to root in the phloem 2063

Plants and the Environment

BACON MA, THOMPSON DS, DAVIES WJ. Can cell wall peroxidase activity explain the leaf growth response of *Lolium temulentum* L. during drought? 2075

DEL MONTE JP, TARQUIS AM. The role of temperature in the seed germination of two species of the *Solanum nigrum* complex 2087

WILL RE, TESKEY RO. Effect of irradiance and vapour pressure deficit on stomatal response to CO_2 enrichment of four tree species 2095

Short Communication

NOLTE T, SCHOPFER P. Viscoelastic versus plastic cell wall extensibility in growing seedling organs: a contribution to avoid some misconceptions 2103

Gene Notes

ANDREEVA AV, KUTUZOV MA, EVANS DE, HAWES CR. Rab-GDP dissociation inhibitor isoforms in *Arabidopsis thaliana* 2109

BURBIDGE A, GRIEVE T, JACKSON A, THOMPSON A, TAYLOR I. Structure and expression of a cDNA encoding a putative neoxanthin cleavage enzyme (NCE), isolated from a wilt-related tomato (*Lycopersicon esculentum* Mill.) library 2111

DE VEYLDER L, SEGERS G, GLAB N, VAN MONTAGU M, INZÉ D. Identification of proteins interacting with the *Arabidopsis* Cdc2aAt protein 2113